ONE-STEP ROTARY FORMING OF UNIFORM EXPANDED MESH

BACKGROUND OF THE INVENTION

This application is a Divisional of Application Serial No. 10/096,873 filed March 14, 2002, now pending.

(i) Field of the Invention

This invention relates to a method and apparatus for the production of expanded metal mesh sheet and, more particularly, relates to a one-step method and apparatus for the production of expanded metal mesh sheet for use in lead-acid battery manufacture.

(ii) Description of the Related Art

The prior art discloses rotary methods for expanding lead strip for use in the manufacture of battery plates. Such methods employ clusters of tools arranged sequentially for preforming and slitting the strip in a first step and completion of slitting of the strip in a second step. Sequential methods have the inherent problems of synchronization of steps, such as roll-to-roll synchronization, requiring certain registering and tracking considerations.

Sequential methods use different tooling for the different steps with the result that lead strip is not "symmetrically processed", in that opposite sides of the strip are not always subjected uniformly and simultaneously to the same pressures, forces, stretching, and the like. In one predominant method in the prior art, a three-shaft cluster of tooling is arranged sequentially with three different tooling devices, namely a "preformer", a "preform slitter" and a "slitter", such that a two-step method results. The preformer and preform slitter form the metal strip by stretching and cutting in a first step and the slitter completes the slitting in a second step.

Wires and nodes on opposite sides of the expanded strip produced by the stretching and forming according to the prior art are not uniform and are not symmetrical. The profile and shape on one side is not the mirror image of the other side resulting in a number of imperfections and defects. This becomes even more significant when higher elongation targets are desired in order to produce lighter grid electrodes for batteries.

Cominco U.S. Patents No. 4,291,443 issued September 29, 1981 and No. 4,315,356 issued February 16, 1982, both included herein by reference, disclose the geometric relationship of conventional 3-shaft cluster tooling or spaced-apart roll pairs employing two

and 146 on their respective discs and are spaced to provide interacting peripheral surfaces as the rolls rotate. Discs 122, 124 have radial notches 174, 176 formed in the opposite sidewalls of alternate circumferential flat portions 144, 146 in opposition to each other, as shown most clearly in Figure 6.

During rotation of the rolls, convexly-shaped tool surfaces 136 of each discs 122 of roll 116 are engaged by like convexly-shaped tool surfaces 138 of adjacent discs 124 of opposed roll 118 to provide longitudinal slits as the curved surfaces penetrate through the plane of the strip for convexly-shaped tool surfaces 136 to stretch slit segments 142 between slits into spaces which are between adjacent discs provided by narrow-radius spacer discs, not shown. The substantially flat portions 144, 146 of the adjacent discs become circumferentially aligned transversely and spaced from each other to hold unslit segments which together form transverse bands 132, shown most clearly in Figures 7, 8 and 9. In like manner, convexly-shaped tool surfaces 138 of discs 124 stretch adjacent slit segments 154 into spaces between the adjacent discs on the opposite side of the plane of the strip.

Opposed alternating radial notches 174, 176 in adjacent disc sidewalls obviate slitting of adjacent flat portions 144, 146, as shown in Figure 6 described above, whereas the absence of notches in every second flat portion 144, 146 causes the radially overlapping flat surfaces to shear and slit the strip therebetween. The slit pattern shown to the left as viewed in Figure 9 is provided to the strip, allowing lateral expansion into the diamond-shaped mesh 149 as shown to the right as viewed in Figure 9, such as by means of rotating expansion as described in detail in US Patents No. 4,291443 and No. 4,315,356.

With particular reference to Figures 4 and 5, roll 180 is rotatably mounted for abutment against roll 118 rotating on shaft 129 to provide centre and edge guiding such as by roll-forming a longitudinal central rib 182 (Figures 8 and 9) by engagement of circumferential ridge 183 of roll 180 with mating circumferential recess 184 of roll 118 and perforating the side edges as designated by numeral 185 by engagement of equispaced circumferential protuberances 186 at each end of roll 180 with mating circumferential recesses 188 on roll 118 to facilitate edge gripping for subsequent lateral expansion into the finished mesh product. The ridge 183 and protruberances 186 with mating circumferential recesses may be reversed on the opposed rolls.